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An Evaluation of Resurgence of Appropriate Communicative Responses in Children with Developmental Disabilities

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An Evaluation of Resurgence of Appropriate Communicative Responses in Children with Developmental Disabilities

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Abstract

An Evaluation of Resurgence of Appropriate Communicative Responses in Children with Developmental Disabilities

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The purpose of the current study was to evaluate the conditions under which resurgence of appropriate communicative responses (mands) would occur with children with developmental disabilities. The experimental preparation consisted of a sequence of conditions that included (a) the reinforcement of one mand (i.e., microswitch activation or card exchange) on a FR 1 schedule, (b) an extinction condition in which the mand was no longer reinforced, (c) the reinforcement of a second mand (i.e., microswitch activation or card exchange) on a FR 1 schedule, and (d) a test for resurgence of the first mand which consisted of placing the second mand on extinction. The results demonstrated resurgence of mands during 2 out of 3 tests for resurgence for one participant. Resurgence of mands was demonstrated during all three tests for resurgence with the second participant.

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CHAPTER 1

Introduction

Aspects of resurgence were documented as early as 1951 when Antonitis (1951) studied response variability in rats when exposed to extinction. Although other researchers described behavior patterns associated with extinction (e.g., Mulick, Leitenberg, & Rawson, 1976; Pacitti & Smith, 1977; Rawson, Leitenberg, Mulick, & Lefebvre, 1977), Epstein is considered the first to investigate and demonstrate resurgence. Resurgence refers to the recovery of a previously extinguished response when a recently reinforced response is extinguished (Epstein, 1983, 1985). Extinction-induced resurgence requires the demonstration of three elements. First, a response must be reinforced and subsequently placed on extinction. Next, a second response is reinforced and placed on extinction. If the previously reinforced (and recently extinguished) response re-emerges during the second extinction condition, the definition of resurgence is met.

Within the basic literature this effect has been demonstrated in pigeons and rats (e.g., Epstein & Skinner, 1980; Lieving & Lattal, 2003; Bachá-Méndez, Reid, & Mendoza-Soylovna, 2007). Following the initial studies demonstrating the effect, subsequent studies have looked at manipulations of behavioral history and its effect on resurgence. For example, Reed and Morgan (2007) linked higher response rates within behavioral history (i.e., rates during reinforcement prior to extinction) to higher response rates during resurgence. In another study, Reed and Morgan (2006) demonstrated a primacy effect during resurgence, where rats returned to most recently learned response; and then emitted the response first-trained during resurgence. Other variables that have been evaluated relative to resurgence include elimination procedures of response 1 and

effects on magnitude of resurgence (Doughty, da Silva, & Lattal, 2007). Other basic studies have shown how modifications to the final extinction condition affect levels of resurgence (Lieving & Lattal, 2003; Bouton & Winterbaur, 2011). Last, additional basic studies of resurgence have examined the phenomenon within a relapse model of extinction-induced drug-seeking behavior and binge-eating (Podlesnik, Jimenez-Gomez, & Shahan, 2006; Quick, Pyszczynski, Colston, & Shahan, 2011; Bouton, 2011).

Studies involving human subjects include demonstrations of resurgence (e.g., Wilson & Hayes, 1996; Bruzek, Thompson, & Peters, 2009; Doughty, Kastner, & Bismark, 2011) and experiments that evaluated behavioral history and effects on resurgence (Doughty, Cash, Finch, Holloway, & Wallington, 2010). Additionally, two studies have shown the resurgence of challenging behavior in developmental disabilities populations (i.e., Lieving, Hagopian, Long, & O'Conner, 2004; Volkert, Lerman, Call, & Trosclair-Lasserre, 2009).

Lieving et al. (2004) documented resurgence during an extinction analysis of challenging behavior for two participants with disabilities. Specifically, the authors (a) established a condition where all topographies of challenging behavior were reinforced; (b) placed the first challenging behavior response that emerged on extinction, and reinforced all other challenging behavior topographies; and (c) placed the second topography of challenging behavior on extinction, creating a test for resurgence of the first topography. The results demonstrated the emergence of distinct challenging behavior topographies during the extinction of other challenging behavior topographies. Thus, Lieving et al. (2004) provided an example of how the resurgence model could be applied practically with developmental disabilities populations.

Volkert et al. (2009) showed resurgence of challenging behavior when trained appropriate requests no longer functioned to gain reinforcement. Volkert et al. (2009)

also demonstrated resurgence occurring during "extinction-like" conditions of thin schedules of reinforcement. Specifically, the authors sought to model treatment integrity issues when children with disabilities enter applied settings and are exposed to thinner schedules of reinforcement. In their study, Volkert et al. (2009) first evaluated whether resurgence of challenging behavior would occur following Functional Communication Training (FCT) when problem behavior and alternative communication responses were placed on extinction. Volkert et al. (2009) employed a sequence of conditions consisting of (a) baseline in which challenging behavior was reinforced, (b) FCT and FCT maintenance in which an alternative communicative response was reinforced and challenging behavior was placed on extinction, and (c) extinction was implemented with both challenging behavior and the previously reinforced communicative response. During the third condition (extinction), challenging behavior re-emerged, demonstrating resurgence. The authors next evaluated whether resurgence would occur when the alternative communication response was placed on thin schedules of reinforcement. In the subsequent evaluation, the third condition included thin schedules of reinforcement for the communication response (rather than extinction as conducted in the first experiment), and extinction of the challenging behavior. Challenging behavior re-emerged for 4 out of the 5 participants across experiments. Volkert et al. (2009) suggested resurgence during thin schedules of reinforcement as a possible model for treatment integrity issues that might cause challenging behavior to re-emerge. Both experiments followed an ABCABC reversal design. These results provided a preliminary demonstration of resurgence during FCT, and replicated results from basic studies (e.g., Lieving & Lattal, 2003) that found that thin schedules of reinforcement produced resurgence. The Volkert et al. (2009) study provided a model for the present investigation.

RATIONALE FOR CURRENT INVESTIGATION

The purpose of the current study was to demonstrate resurgence of a previously reinforced, but recently extinguished, appropriate communicative response (mand) when a second mand no longer functioned to gain access to a preferred item. Thus, I sought to provide an additional demonstration of resurgence of clinically relevant topographies of behavior with individuals with developmental disabilities (see Lieving et al., 2004; Volkert et al., 2009); and the first demonstration of resurgence of an appropriate communication response. It is important to demonstrate resurgence across topography within the area of developmental disabilities because it is difficult to control for behavioral history; and it is likely that histories of reinforcement of challenging behavior and appropriate communication are distinct.

CHAPTER 2

Method

PARTICIPANTS

Two individuals with developmental disabilities participated in this study. Both participants met the inclusion criterion consisting of limited communication skills.

John was 6 years old and had been previously diagnosed with autism. He had been diagnosed at age 3 with PDD-NOS, later changed to autism, and had a significant delay in acquiring language. At age 4, John communicated using one-word requests. Since that time, John made requests using 3-5 word phrases or sentences, and engaged in some conversation exchanges. He had a history of challenging behavior which included grabbing, pushing and pulling, verbal insults and protests, whining, crying, and biting.

Wilson was 9 years old and had been previously diagnosed with autism. Wilson was non-verbal and used a voice-output device to communicate needs, some sign approximations, and pre-linguistic gestures such as bringing the remote to caregivers. Wilson had a history of engagement in challenging behavior including grabbing, biting, and elopement.

SETTINGS AND MATERIALS

The study was conducted in a room at Wilson's school and a room in John's home. The child and communicative partner sat in chairs opposite each other at the table. Both communication devices (micro-switch and laminated 4x6 card) were placed on the table at equal distance from the participant, and preferred items were present. A stopwatch and video camera were used for recording sessions and data collection.

MEASUREMENT AND Response Definitions

Trained observers collected data on all target behaviors using computers. Card exchange was defined as the child picking up the card with his hand and extending his arm toward another person; or the child sliding the card across a table so that a portion of the card extended beyond the edge of the table. A microswitch press was defined as depression of button with hand, noted by a "click" sound, when button was flat on a surface.

For each participant, a communicative response already in his repertoire was selected to serve as a control response. This was done to rule-out response variability as a confounding variable during instances of resurgence. For John, this was a hand raise defined as vertical extension of the hand with flat palm. For Wilson, this was a sign approximation for "please" defined as palm of hand on abdomen moving in a circular motion.

INTEROBSERVER AGREEMENT

Two observers scored video of sessions independently for 33% for each participant. Agreement data were calculated by dividing each session into successive 10-s intervals and then dividing the number of intervals with exact agreements (i.e., two observers recording the same number of occurrences of a response in a given 10-s interval) by the number of intervals with agreements plus disagreements, multiplied by 100. For John, agreement was 95% for card exchange, 99% for microswitch. For Wilson, agreement between communication responses scored was 97% for card exchange and 95% for microswitch press. For control responses for both participants agreement was 100%.

EXPERIMENTAL DESIGN

The current study was conducted within a ABCB repeated design (A = FR 1 response 1; B = extinction; C = FR 1 response 2). During FR 1 response 1, contingent on the target mand (selected at random, and alternated with the second mand during FR 1 response 2), access to the preferred tangible item was provided for 30s. The criterion for moving to extinction was 5 minutes of efficient responding (manding within 10s of the removal of the preferred item). During extinction, the target mand reinforced during FR1 response 1 no longer resulted in access to the preferred item. The target mand was considered "extinguished" when it did not occur for 3 consecutive minutes. During FR1 response 2, contingent on the second target mand, the preferred activity was provided for 30s. Criterion for moving to extinction was 5 minutes of efficient responding (manding within 10s of removal of preferred item). During the final extinction condition (i.e. test for resurgence), access to the preferred tangible was withheld throughout. A demonstration of resurgence occurred if the previously extinguished target mand re-emerged at levels above the control response during this condition. The four conditions were repeated three times on separate days to replicate results.

SELECTION OF PREFERRED ITEMS

Caregiver interviews were conducted to select preferred items to be used as reinforcers during the study. For John, a TV remote and TV were identified as his most preferred activity. For Wilson, a portable movie player was identified as his most preferred activity.

PROCEDURE

Mand Training. Prior to the implementation of the experimental conditions, mand training was conducted. Communication materials for both responses (microswitch

and card) were placed on a table directly in front of the child at an equal distance. A four-step least-to-most prompting method was used to train target mands. First, the participant was given free access to the preferred item for 1 minute before it was removed. If the target response did not occur within 10 s of the removal of the item, a verbal prompt was provided. If the child responded within 10 s of the verbal prompt, access to the preferred item was provided for 30 s. If the child did not respond to the verbal prompt, a gestural prompt was provided, followed by a full physical prompt. If the participant had difficulty acquiring the response with both communication materials on the table, the non-target response was temporarily removed and replaced when consistent responding was demonstrated with the target mand.

FR 1 Response 1. When the child met the criteria of 5 min of efficient responding, defined by producing target response within 10 s of removal of the preferred item for 5 consecutive minutes, the second condition began.

Extinction. During extinction, both card and microswitch were on the table and access to the preferred item was withheld throughout the condition. Following 3 consecutive minutes in which no target mands were observed, the next condition was initiated.

FR 1 Response 2. This condition was similar to the FR 1 response 1 condition, except that the second target mand was reinforced on a FR 1 schedule of reinforcement. The criterion for moving to the next condition was met when the participant exhibited 5 min of efficient communication as defined above.

Extinction: Test for Resurgence. The procedures for this condition were identical to the extinction condition described above. Following 3 consecutive minutes in which no target mands were observed, the session was terminated.

CHAPTER 3

Results

Cumulative responses per condition are displayed in 1-min bins in *Figure 1* for John and *Figure 2* for Wilson. During FR 1 response 1, frequency of the reinforced mand was elevated and consistent, and zero occurrences of the second mand were observed with both participants. During each of the initial extinction conditions across the evaluation, a high frequency of responding for the recently reinforced mand was observed for both participants. During each FR 1 response 2 condition across the evaluation, steady responding for the reinforced mand was observed while response 1 remained at zero for both participants. During the final extinction condition, resurgence of mands was observed for John during 2 of the 3 tests for resurgence., Resurgence of mands was observed during each of the 3 tests for resurgence with Wilson. It should also be noted that with Wilson, the frequency of responses across extinction conditions over the course of the evaluation decreased with each subsequent exposure.

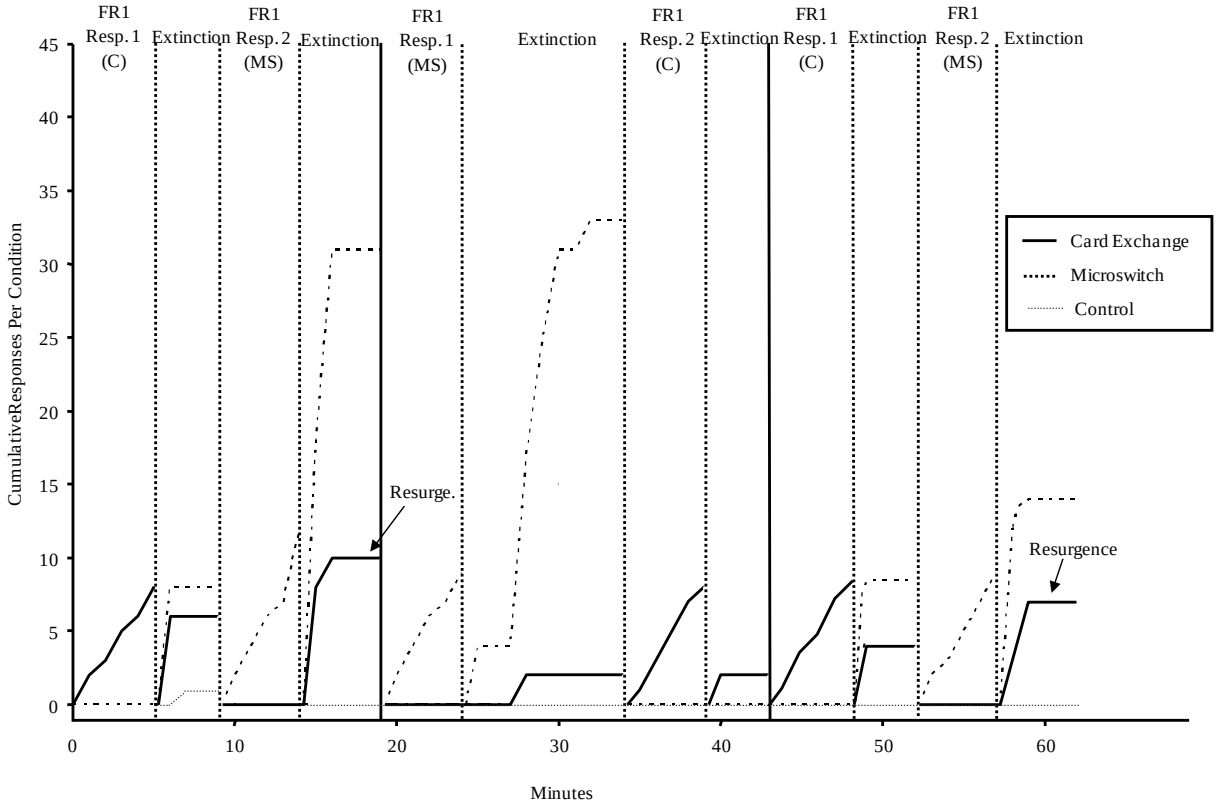

Figure 1. Cumulative responses per condition for John. Data are depicted in 1-min bins. Vertical dashed lines indicate transitions between conditions. Vertical solid lines indicate start of new sessions on new days. C = card exchange and MS = miscroswitch in the condition labels.

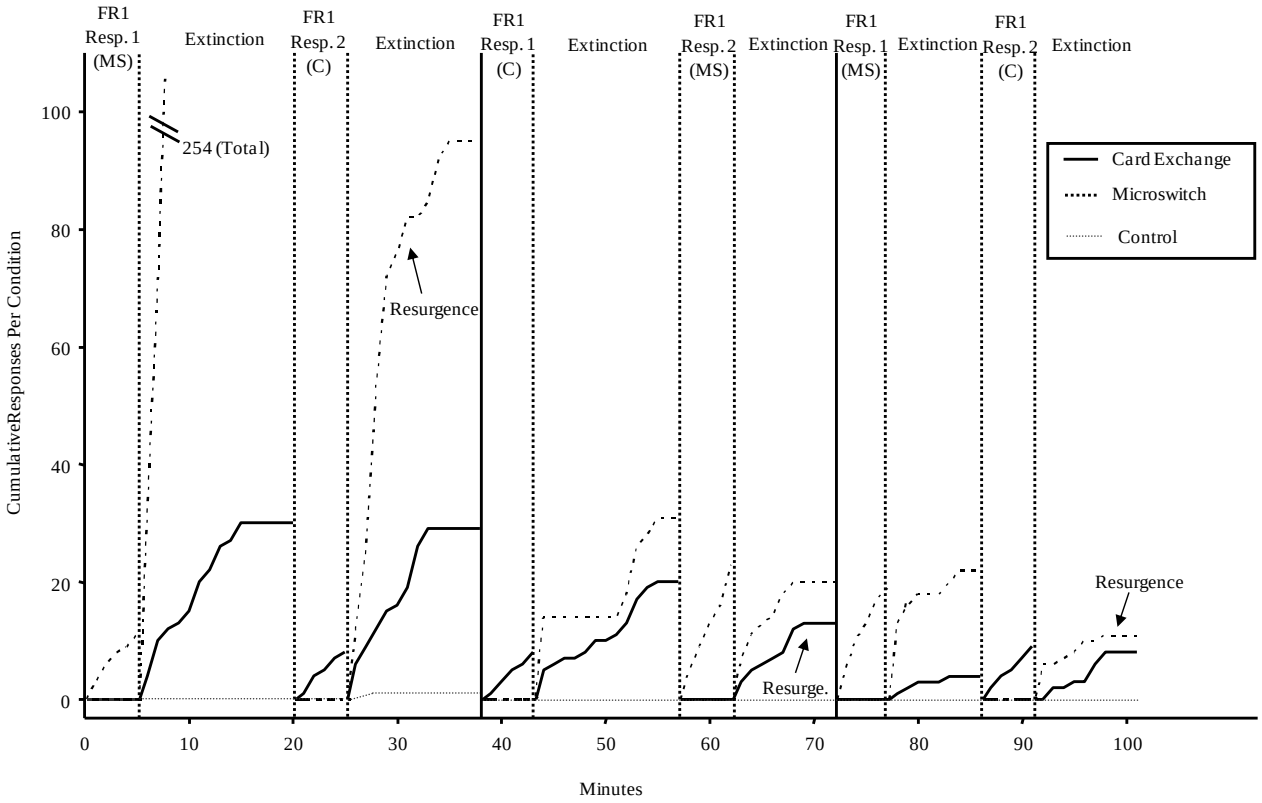

Figure 2. Cumulative responses per condition for Wilson. Data are depicted in 1-min bins. Vertical dashed lines indicate transitions between conditions. Vertical solid lines indicate start of new sessions on new days. C = card exchange and MS = miscroswitch in the condition labels.

CHAPTER 4

Discussion

The first trained mand re-emerged during the first and third test conditions for John, but did not occur for the second test during resurgence (*Figure 1*). For Wilson, resurgence of the first trained mand was demonstrated during all three test conditions (*Figure 2*). These findings are consistent with previous studies in terms of percentage of tests of resurgence in which resurgence was demonstrated within and across participants. For example, Volkert et al. (2009) showed resurgence of problem behavior when a trained communication response was no longer reinforced for 4 out of 5 participants. Likewise, Bruzek et al. (2009) demonstrated the resurgence of infant-caregiving responses in 5 out of 7 participants.

This study adds to the current literature on resurgence by replicating previous studies demonstrating the phenomenon (e.g., Epstein & Skinner, 1980; Bachá-Méndez et al., 2007; Bouton & Winterbauer, 2010; Kearns & Weiss, 2007). In particular, this study replicates resurgence within the population of persons with developmental disabilities (Volkert et al., 2009; Lieving et al., 2004). Additionally, the current study extends the literature on resurgence by showing the effect with a new topography. The results of this study also add to the to the literature pertaining to communication training with persons with developmental disabilities by showing conditions under which appropriate communication will re-emerge, specifically demonstrating that this topography follows patterns of resurgence. Developmental disabilities populations, in particular, face frequent communication breakdowns and relapses in treatment, as well as temporary

impediments such as broken or lost communication devices. Thus, the conditions that often result in the resurgence of previously reinforced and extinguished behaviors are likely present on a consistent basis. Therefore, further investigations of this phenomenon with individuals with developmental disabilities, across different types of responses (i.e., appropriate communication; challenging behavior) are warranted.

LIMITATIONS

Several limitations should be noted when considering the current results. First, as demonstrating resurgence requires repeated measure over time, it is possible that repeated measures and repeated exposure to the different conditions may result in discrimination. For example, in the one instance that resurgence did not occur, discrimination may have been responsible. Specifically, it appeared that John was attending to the timer, and when it sounded he said, "No," and held the remote tightly with both hands. In this instance, the target mand failed to resurge. One way to reduce the risk of discrimination would be to minimize or eliminate environmental cues such as countdowns or limit repeated exposure to two test conditions while replicating with additional participants.

Another limitation was our inability to control for histories of reinforcement with the respective target mands. However, it should be noted that for John, anecdotal reports suggested that he had little exposure to the mands targeted in the current study. It should also be noted that Wilson had previously used both card exchange and a microswitch in other environments. Though, neither card exchange nor microswitch was used consistently within his current environments.

With regard to histories of reinforcement, we can only gather anecdotal information about long and short-term histories that might contribute to the resurgence of mands. This however, provides an important rationale for the study of different topographies that function to gain the same outcome. For example, challenging behavior and appropriate communication might be used to gain access to preferred items but reinforcement histories are likely different. One topography might be more likely than another to re-emerge during extinction conditions. Thus, manipulating behavioral history to increase the likelihood that appropriate communication re-emerges during communication breakdowns would have great therapeutic value.

Another potential limitation was our criterion for terminating the extinction condition (e.g. no responding for 3 consecutive minutes). The original criterion was 5 minutes in the absence of responding (see Bruzek et al., 2009), but as a result of the frequency and intensity of challenging behavior topographies that emerged during extinction, we shortened the criterion to 3 minutes. Thus, it is possible that 3 minutes was not sufficient to conclude that mands were extinguished. The debate over the definition of extinction, and what specific criteria must be met for a response to be considered "extinguished" may constitute a future area of research. Future studies should evaluate resurgence of challenging behavior and appropriate communication when varying durations of extinction are employed (e.g., Bruzek et al., 2009). This might be more easily explored in a population that does not exhibit high rates of challenging behavior.

FUTURE RESEARCH

While there are different studies that have demonstrated resurgence, some clarification of the definition of resurgence may be warranted. Some studies have used a single condition that included extinction and simultaneous reinforcement of the second response prior to the test for resurgence (e.g., Lieving et al., 2004). However, other studies implemented extinction and reinforcement of the second response sequentially (e.g., Lieving & Lattal, 2003). A comparison study might help clarify conditions necessary to produce resurgence, and standardize the definition within research. In addition, some studies have included a control response to rule out extinction-induced response variability (Bruzek et al., 2009) whereas others did not (Lieving & Lattal, 2003; Volkert et al., 2009).

Many treatments for children with communication delays include repeated extinction conditions for challenging behavior and even for certain pre-linguistic communication topographies. This is done to "shape up" more socially appropriate forms of communication. One future avenue of research might explore how repeated exposures to extinction affect magnitude and types of topographies likely to resurge.

In treatments that teach appropriate requesting, it might be beneficial to manipulate conditions so that certain forms of communication would be more likely to re-emerge during communication breakdowns such as pointing, such that challenging behavior might be less likely to re-emerge during treatment breakdowns. Future studies should evaluate ways to manipulate reinforcement histories to make specific, appropriate forms (such as pointing or gesture) resistant to extinction even with repeated exposure,

while decreasing the likelihood for less preferred forms of communication such as aggression or self-injury.

The findings of basic studies also provide suggestions for future translational and applied studies. Other variables to manipulate that have been explored in the basic literature that affect resurgence include sequence effects such as primacy and recency (Reed & Morgan, 2006). Understanding sequence effects might provide a better understanding of why individuals faced with communication challenges revert to challenging topographies, as often these topographies are acquired first. It might give additional support for early intensive interventions for individuals with communication delays, even before challenging behavior emerges in their repertoire.

In addition, looking at variables such as rates of reinforcement (Podlesnik & Shahan, 2009) and schedules of reinforcement (Doughty et al., 2007; da Silva, Maxwell, & Lattal, 2008) and how they might affect resurgence of appropriate responses and challenging behavior in this population, would likely help researchers and clinicians understand better ways to reduce the probability of treatment relapse. For instance, it might strengthen resistance to extinction of appropriate communication to respond on a variable-interval schedule, or at lower rates after the response is trained. In applying this notion to challenging behavior, it is possible that reinforcing challenging behavior at high rates and on a fixed interval schedule prior to initiating communication-based treatments (that include extinction), might decrease the likelihood of resurgence and reduce treatment relapse.

Another avenue for future study could examine reinforcer magnitude (Podlesnik & Shahan, 2009) and its effect on resurgence. The current study entailed access to a preferred item for 30 s. However, in applied settings, the duration of reinforcement intervals typically vary. Evaluating how varying levels of magnitude of reinforcement (either length of time or amount of reinforcement), might uncover patterns that better approximate those in applied settings and reveal how we might manipulate reinforcer magnitude to increase or decrease resurgence (depending on target topography).

In addition, basic studies targeting human populations also provide grounds for future research with individuals with developmental disabilities. For instance, Doughty et al. (2010) suggested that responses with a longer training history predict resurgence. This would be important to investigate in applied populations because it might lead to recommendations for lengthier training of appropriate communication responses to increase likelihood of resurgence of appropriate communication. It also might provide evidence for beginning treatment early to shorten behavioral history of reinforcement for challenging behavior and decrease probability of resurgence of challenging behavior.

In terms of extending the literature on appropriate communication, it would be important to demonstrate resurgence across functions of behavior (Bruzek et al., 2009). Most of the basic literature looks at reinforcement with positive-tangible contingencies. In moving into application, showing that results are replicable for attention-maintained behaviors as well as escape-maintained behaviors in this specific population would extend findings to help with treatment of behaviors that occur to gain access to different types of reinforcement.

In addition to looking at behavioral history, looking at modifications during the extinction condition could lead to ways to mitigate resurgence of challenging behavior and encourage resurgence of appropriate mands. Evaluating whether availability of other reinforcement, or availability of multiple communication modalities within the environment affect likelihood or magnitude of resurgence might be important in working toward reducing treatment relapse in this population.

Within the specific population, it might be relevant to look at how item preference affects probability of extinction-induced resurgence. Other items not yet documented in basic literature that are relevant to the current population would be studying how response effort affects resurgence, or how changes in context and persons implementing the study affect resurgence. Bridging discoveries made by work in basic research and extending translational work within new populations such as children with developmental disabilities and across distinct behavior topographies will help articulate different ways that we can better help this population.

REFERENCES

Antonitis, J. J. (1951). Response variability in the white rat during conditioning, extinction, and reconditioning. *Journal of Experimental Psychology, 42,* 273-281.

Bachá-Méndez, G., Reid, A. K., & Mendoza-Soylovna, A. (2007). Resurgence of integrated behavioral units. *Journal of the Experimental Analysis of Behavior, 87*, 5-24.

Bouton, M. E. (2011). Learning and the persistence of appetite: Extinction and the motivation to eat and overeat. *Physiology & Behavior, 103*, 51-58.

Bouton, M. E., & Winterbauer, N. E. (2011). Mechanisms of resurgence II: Response-contingent reinforcers can reinstate a second extinguished behavior. *Learning & Motivation, 42,* 154-164.

Bouton, M. E., & Winterbauer, N. E. (2010). Mechanisms of resurgence of an extinguished instrumental behavior. *Journal of Experimental Psychology, 36*, 343-353.

Bruzek, J. L., Thompson, R., & Peters, L. (2009). Resurgence of infant caregiving responses. *Journal of the Experimental Analysis of Behavior, 92*, 327–344.

da Silva, S. P., Maxwell, M. E., & Lattal, K. A. (2008). Concurrent resurgence and behavioral history. *Journal of the Experimental Analysis of Behavior, 90*, 313-331.

Doughty, A. H., Kastner, R. M., & Bismark, B. D. (2011). Resurgence of derived stimulus relations: Replication and extensions. *Behavioural Processes, 86*, 152-155.

Doughty, A. H., Cash, J. D., Finch, E. A., Holloway, C., & Wallington, L. K. (2010). Effects of training history on resurgence in humans. *Behavioural Processes, 83*, 340-343.

Doughty, A. H., & Oken, G. (2008). Extinction-induced response resurgence: A selective review. *Behavior Analyst Today, 9*(1), 27-33. Retrieved from Academic Search

Doughty, A. H., da Silva, S. P., & Lattal, K. A. (2007). Differential resurgence and response elimination. *Behavioural Processes, 75,* 115-128.

Epstein, R. (1983). Resurgence of previously reinforced behavior during extinction. *Behaviour Analysis Letters, 3,* 391-397.

Epstein, R. (1985). Extinction-induced resurgence: Preliminary investigations and possible applications. *The Psychological Record, 35,* 143-153.

Epstein, R., & Skinner, B. F. (1980). Resurgence of responding after the cessation of response independent reinforcement. *Proceedings of the National Academy of Sciences, 77,* 6251-6253.

Kearns, D. N., & Weiss, S. J. (2007). Recovery of Pavlovian sign-tracking (autoshaping) following the discontinuation of inter-trial interval food in rats. Behavioural Processes, 75, 307-311.

Lattal, K. A. & Pipkin, C. (2009). Resurgence of previously reinforced responding: Research and application. *Behavior Analyst Today, 10,* 254-266.

Lieving, G. A., Hagopian, L. P., Long, E. S., & O'Conner, J. (2004). Response-class hierarchies and resurgence of severe problem behavior. *The Psychological Record, 54,* 621-634.

Lieving, G. A., & Lattal, K. A. (2003). Recency, repeatability, and reinforcer retrenchment: An experimental analysis of resurgence. *Journal of the Experimental Analysis of Behavior,80,* 217-233.

Mulick, J. A., Leitenberg, H., & Rawson, R. A. (1976). Alternative response training, differential reinforcement of other behavior, and extinction in squirrel monkeys (Saimir i sciureus). *Journal of the Experimental Analysis of Behavior, 25,* 311-320.

Pacitti, W. A., & Smith, N. F. (1977). A direct comparison of four methods for eliminating a response. *Learning and Motivation, 8,* 229-237.

Podlesnik, C. A., & Shahan, T. A. (2009). Reinforcer satiation and resistance to change of responding maintained by qualitatively different reinforcers. *Behavioural Processes, 81,* 126-132.

Podlesnik, C. A., Jimenez-Gomez, C., & Shahan, T. A. (2006). Resurgence of alcohol seeking produced by discontinuing non-drug reinforcement as an animal model of drug relapse. *Behavioural Pharmacology, 17,* 369-374.

Quick, S. L., Pyszczynski, A. D., Colston, K. A. & Shahan, T. A. (2011). Loss of alternative non-drug reinforcement induces relapse of cocaine-seeking in rats: Role of dopamine D-1 receptors. *Neuropsychopharmacology, 36,* 1015-1020.

Rawson, R. A., Leitenberg, H., Mulick, J. A., & Lefebvre, M. F. (1977). Recovery of extinction responding in rats following discontinuation of reinforcement of alternative behavior: A test of two explanations. *Animal Learning and Behavior, 5,* 415-420.

Reed, P. & Morgan, T.A. (2006). Resurgence of response-sequence during extinction in rats shows a primacy effects. *Journal of the Experimental Analysis of Behavior*, 86, 307-315.

Reed, P., & Morgan, T. A. (2007). Resurgence of behavior during extinction depends on previous rate of response. *Learning & Behavior, 35,* 106–114.

Wilson, K. G., & Hayes, S. C. (1996). Resurgence of derived stimulus relations. *Journal of the Experimental Analysis of Behavior, 66,* 267-281.

Volkert, V.M., Lerman D.C., Call, N.A., & Trosclair-Lasserre, N. (2009). An Evaluation of Resurgence During Treatment with Functional Communication Training. *Journal of Applied Behavior Analysis, 42*, 145-160.